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Devoted to the Conversion, Transmission and Distribution of Energy

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ELECTRICITY IN THE UNION IRON WORKS.

BY R. H. FENKHAUSEN.

STRAIGHT LINE DIAGRAM.

BY J. P. ZIPF.

FACTORY LIGHTING AND WORKMEN'S COMPENSATION.

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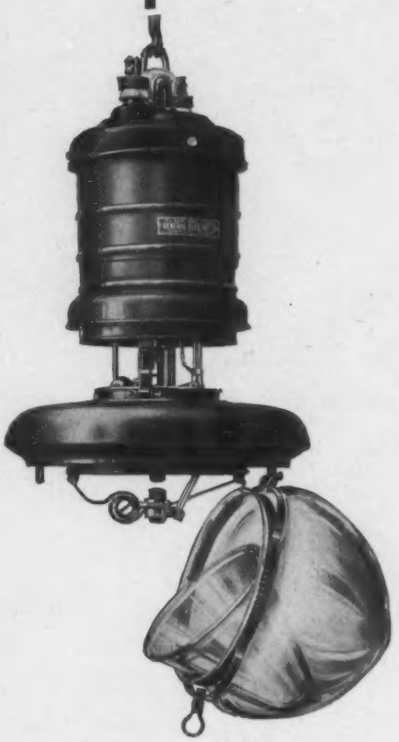

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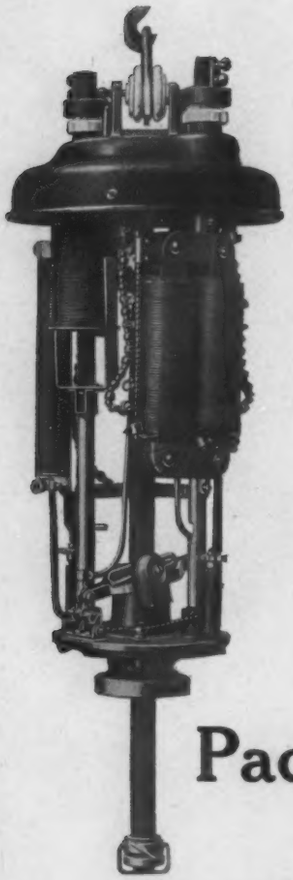

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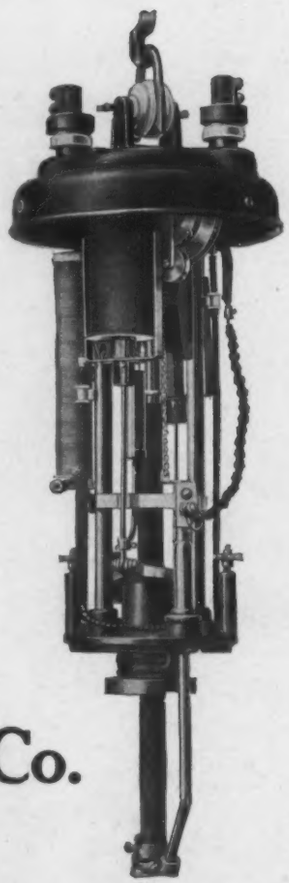

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POWER AND GAS
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ELECTRICITY IN THE UNION IRON WORKS

BY R. H. FENKHAUSEN.

Union Iron Works, San Francisco.

During the early part of the year 1911 the management of the Union Iron Works Company, San Francisco, commenced work on a comprehensive plan of improvements, which when completed will have accomplished the reconstruction of practically the entire plant.

One of the first problems encountered was the rehabilitation of the power plant, which had become inadequate to the rapidly increasing power demands of the various departments. A description of the old power plant will be found in the June, 1901, issue of this journal and it will be noted that practically all machine tools were at that time operated from line shafts driven by electric motors.

Before starting work on the new plant the heavily overloaded equipment in the old was first relieved by the elimination of all possible line shafts and the installation of individual motors on each machine tool. Several hundred horsepower were eliminated in this way because in most cases the shafting was old and badly out of line.

In laying out the new power system the advantages of the Diesel engine and the steam turbine were carefully balanced against those of purchased power, but the poor load factor incidental to the operation of the plant for only eight hours out of the twenty-four made the fixed charges on the plant too high to successfully compete with the rates which the power

companies were able to offer for power used off peak.

Although several power companies offered favorable rates the contract was awarded to the Pacific Gas & Electric Company. Continuity of service was paramount and it was felt that the company's big station at Humboldt and Georgia streets offered maximum security against interruptions.

Up to this time all electric power had been furnished 220 volt d.c., but as soon as the power contract was signed arrangements were made to use alternating current in all new shops in order to save transformation losses.

Several new shops then near completion were equipped with a.c. motors and the 440 volt, 3 phase system, was selected for distribution. As the new power house had not yet been started a temporary 2400 volt, 2-phase, feeder was run into the plant and a 400 k.v.a. bank of transformers (Scott connected) installed to carry the load.

A 75 kw., 220 v., d.c. generator belted to a 2400 v., 2 phase induction motor installed several years before to carry the night load was also pressed into regular service, to assist the old d.c. plant on the peak. After having thus temporarily provided for the immediate growth of the plant work was started in earnest on the new power system.

New Power House Building.

The power house building is situated at the intersection of 20th and Michigan streets and architecturally is one of the ornaments of the Potrero district. It is built of reinforced concrete, the architecture being Spanish Renaissance and the roof tiled in Mission style. The building is 126 by 40 ft. and is two stories in height, but owing to the rise in grade of 20th street the second or main floor is on the street level. Fifteen feet has been left between the building and the sidewalk, and this space together with the entire surrounding area is covered with well-kept lawns and flowers.

A ten-ton traveling crane spans the entire operating floor, which at night is illuminated by flaming arc lamps.

The lower floor is on the level of the works and is used by the electrical department as a repair shop and storeroom, with the exception of the east end where the high tension bus structure and switch compartments are located.

In addition to the step down transformers and distributing switchboard the station contains rotary converters for carrying the direct current load and air compressors for the operation of the many pneumatic tools in use throughout the plant.

Kinds of Power Furnished.

The construction and repair of ships which is one of the most important branches of the company's activities, is a complex business and the diversified processes involved require many different kinds of power, a few of which are given below:

Compressed air at 100 lb. per sq. in. for pneumatic tools, etc.
Low pressure air at 10 to 32 oz. for forges, oil burners, etc.
Hydraulic at 1700 lb. per sq. in. for presses, lifts, etc.
Salt Water at 60 lb. per sq. in. for sprinkling, etc.
Salt water at 120 lb. per sq. in. for fire protection.
70 v., d.c. for electric welding.
125 v., d.c. for excitation and battery charging.
230 v., d.c. for general d.c. power purposes.
330 v., d.c. for submarine boat charging.
70 v., 3-phase, 60-cycle, a.c., for starting rotary converters.
140 v., 3-phase, 60-cycle, a.c., for running rotary converters.
208 v., 3-phase, 60-cycle, a.c., for distributing 120 volt lighting.
240 v., 3-phase, 60-cycle, a.c., for starting air compressors.
480 v., 3-phase, 60-cycle, a.c., for general a.c. power.
120 v., 1-phase, 60-cycle, a.c., for ship and plant lighting.

Each type of service will be taken up in detail later on in this article.

Eleven k.v. Cables and Switches.

Three-phase, 60-cycle current is furnished at 11,000 volts over duplicate underground cables following different routes and each tied in to a different station of the supply company. These cables run directly to the concrete bus structure on the lower floor of the power house where the necessary disconnecting and oil switches are installed. The oil switches are operated by remote mechanical control from the station panel on the main switchboard.

Disconnecting switches are provided which permit any or all poles of any oil switch to be short-circuited and then isolated so that work can be performed on the 11 k.v. switches without danger and without interruption to the service. All switch and bus compartments are provided with wire plate glass doors permitting inspection of the entire installation at all times.

Transformers.

The transformer installation consists of:

Three 500 k.v.a., 11000/480 v., shell type, self-cooled, transformers, delta-connected for general a.c. power distribution, and provided with half taps to furnish 240 v. starting current for the air compressor motors.

Three 50 k.v.a., 11000/120 v., core type, self-cooled, transformers, star-connected with grounded neutral for general lighting distribution.

Two 225 k.v.a., 11000/140 v., 3-phase, core type, self-cooled transformers for the rotary converters and provided with half taps to furnish 70 v. starting current.

Switchboard.

The main switchboard is composed of 18 vertical panels of natural black Monson slate 90 in. high. Its total length is 34 ft., which, with the three ft. ornamental grill work gate on each end occupies the entire width of the building.

From left to right the service of the various panels is as follows:

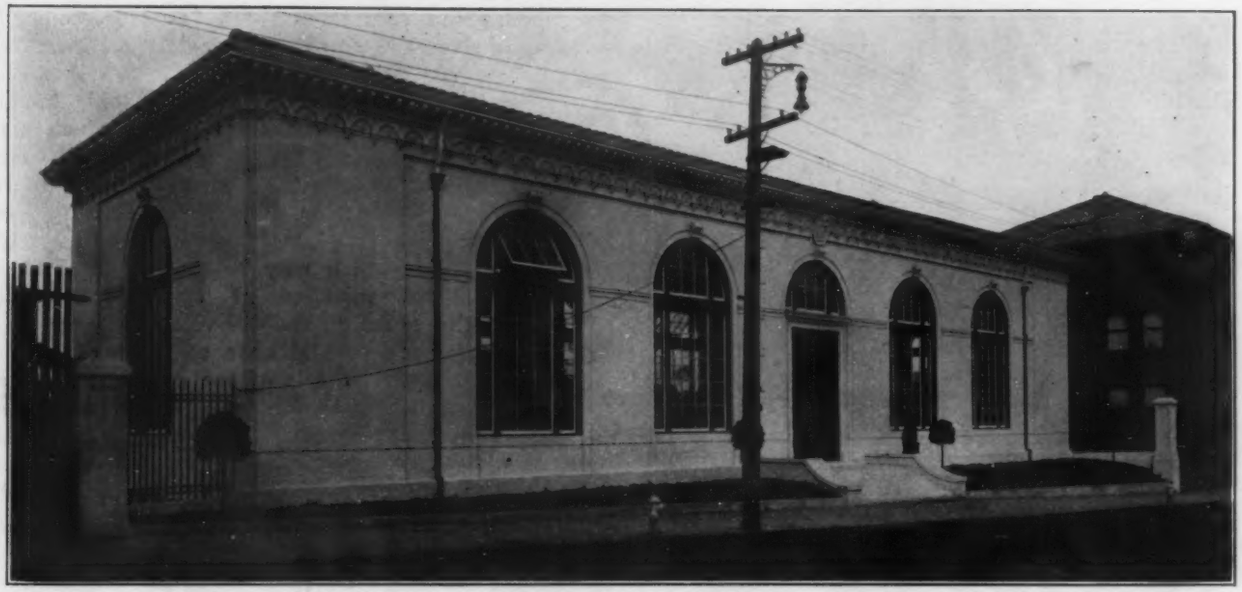
1—28 in. a.c. feeder panel; 2—600 amp., 480 v., feeders.
2—28 in. a.c. feeder panels; 2—400 amp., 480 v., feeders.
4—28 in. a.c. 450 h.p., 480 v., synchronous motor panels.
1—32 in. a.c. 11000 v., station panel.
1—16 in. d.c. exciter panel, 500 amp., 125 v.
1—28 in. a.c. lighting panel; 2—60 amp., 208 v., feeders.
2—20 in. a.c. rotary converter panels, 1200 amp., 140 v.
2—16 in. d.c. rotary converter panels, 1200 amp., 230 v.
4—16 in. d.c. feeder panels, 600 amp., 230 v.

All machine and feeder circuits are provided with watt-hour meters in order that each department may be charged with the proper proportion of the power house cost. All a.c. feeder circuits are protected by time limit overload relays, and three-way ammeter switches enable any unbalance on the system to be readily detected.

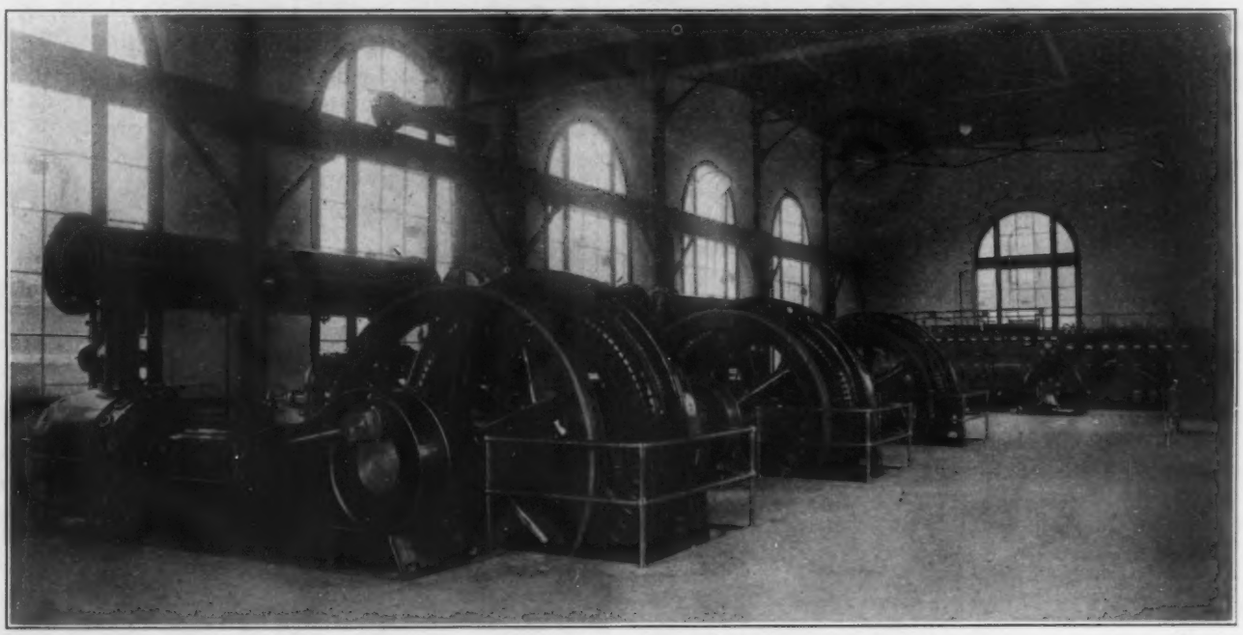
Bus Bars and Cable Work.

All connections between the low tension side of the transformers and the bus bars have been made with rectangular bare copper bar polished and lacquered and cable has been eliminated wherever the use of bar copper would improve the appearance of the installation.

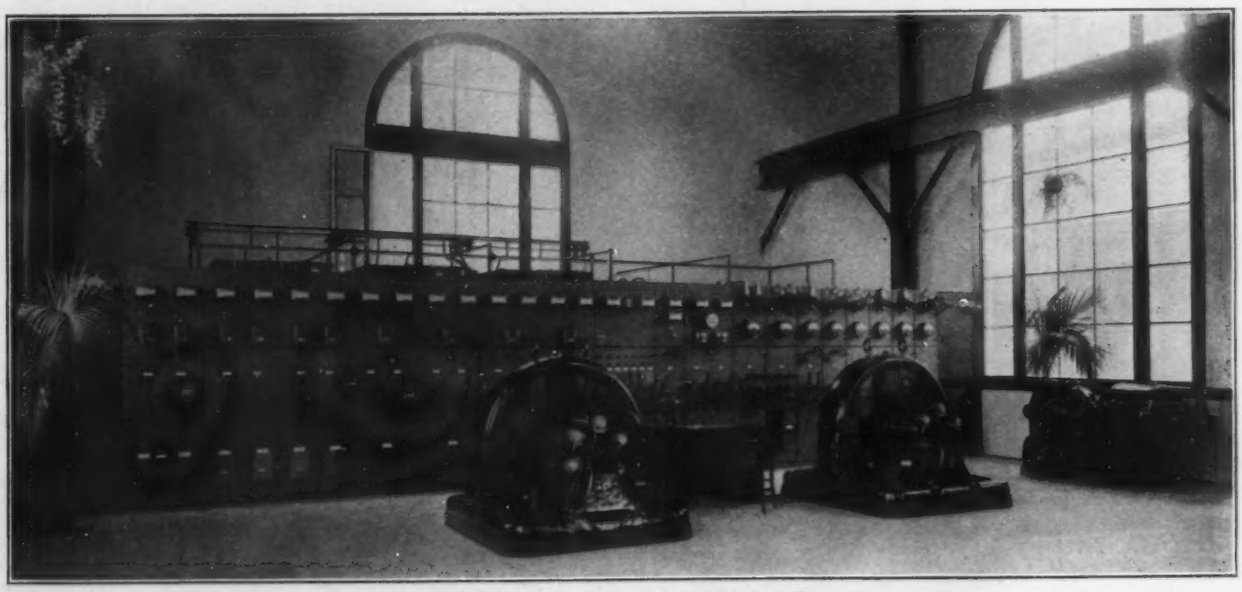
The cables between machines and switchboard are varnished cambric insulated, asbestos covered, station



Exterior of New Power Plant.



Interior of New Power Plant.



Rotary Converters and Switchboard.

cables carried on racks to the machine foundations and thence in fibre conduit to the terminals. Single conductor cable was used exclusively for this work owing to the difficulty of finding space for multi-conductor cables in the floor slabs.

All out-going feeder cables both a.c. and d.c. are paper-insulated, lead covered, and will be described in connection with the distribution system.

Compressed Air Service.

The heaviest load on the power plant is the compressed air service at 100 lb. per sq. in. from which operates all the air drills, chipping and caulking hammers, etc., used in boilermaking and shipbuilding.

Compressed air is also used for innumerable other purposes, such as blowing out motors and machinery and operating small steam engines and hoists on ships laid up for repairs.

The air compressors are of the Franklin type manufactured by the Chicago Pneumatic Tool Company and are two-stage machines 28 in. and 17 in. dia. by 26 in. stroke, each having a capacity of 2500 cu. ft. of free air per minute. Three of these machines are at present installed but foundations, wiring and switchboard equipment for a fourth are already in place.

The air intake valves are of the positively operated Corliss type and the discharge valves are of the poppet type. An inter-cooler reduces the temperature of the air after its discharge from the initial stage. Salt water is used in the water jacket and intercooler circulating system and has caused no trouble so far due to the rapid circulation kept up in the entire system to prevent the deposit of seaweed, etc.

A forced feed lubrication system is used for the cylinders and Corliss valves but the rest of the machine is oiled by multiple sight feed oilers piped to all parts of the compressors.

On the main shaft of each compressor is mounted the revolving field of a General Electric three-phase, sixty cycle, 480 v., 138½ r.p.m., synchronous motor rated 450 h.p. at unity power factor. Amortisseur windings are installed on the revolving field and the motors are started up by the application of half voltage to the stator windings. The motors accelerate quite rapidly as an atmospheric relief valve on the compressor is left open when starting up. After starting current has fallen to about 600 amp. per phase, full voltage is applied to the stator and the field switch closed. The atmospheric exhaust valve is then closed, placing the machine on the line. On several occasions during the operation of the plant all three compressors have been started and put on the line in less than two minutes.

The compressors being synchronously driven are necessarily constant speed machines and must therefore govern by unloading at a predetermined pressure. Several types of governors acting on both the intake and discharge sides of the compressors are now under test for efficiency but as yet no final choice has been made.

In order that constant pressure may be maintained at the center of air distribution a one-half inch pressure pipe has been carried back to the power house from the end of the main line, and the governors and pressure gauges are operated from this source. By this means the compressors are "overcompounded" (to use an electrical term) and line-drop compensated for as effectively as in a d.c. generator.

For use at night several small portable motor-driven compressors on trucks are in use which may be run to any department requiring compressed air to operate a few pneumatic tools after working hours. These sets average 200 cu. ft. capacity each and are driven by induction motors provided with flexible cables and plugs, which may be quickly inserted in connection boxes installed at convenient points throughout the works on the 480 volt a.c. system. A small receiver with several hose connections is suspended between the wheels of the sets and by connecting direct to these the air leakage due to keeping the entire air distribution system under pressure all night is avoided.

Excitation System.

Excitation for the synchronous compressor motors is furnished by a three-bearing motor generator set consisting of a 440 volt, 1200 r.p.m., induction motor direct connected to a 50 kw., 125 volt, compound-wound, d.c., inter-pole generator. This set is started from the half-voltage bus bars, no compensator being required, and is large enough to take care of all future additions to the compressor plant as well as the charging of storage battery trucks and the supply of 110 volt, direct current to the repair shop for the testing of the numerous 110 volt d.c. motors sent to the shop from ships under repair at the works.

Rotary Converters.

Direct current for general power distribution at 230 volts is furnished by two 3-phase, 60 cycle, 1200 r.p.m., shunt-wound, rotary converters rated 200 kw. at unity power factor, and operated in parallel on the direct current end.

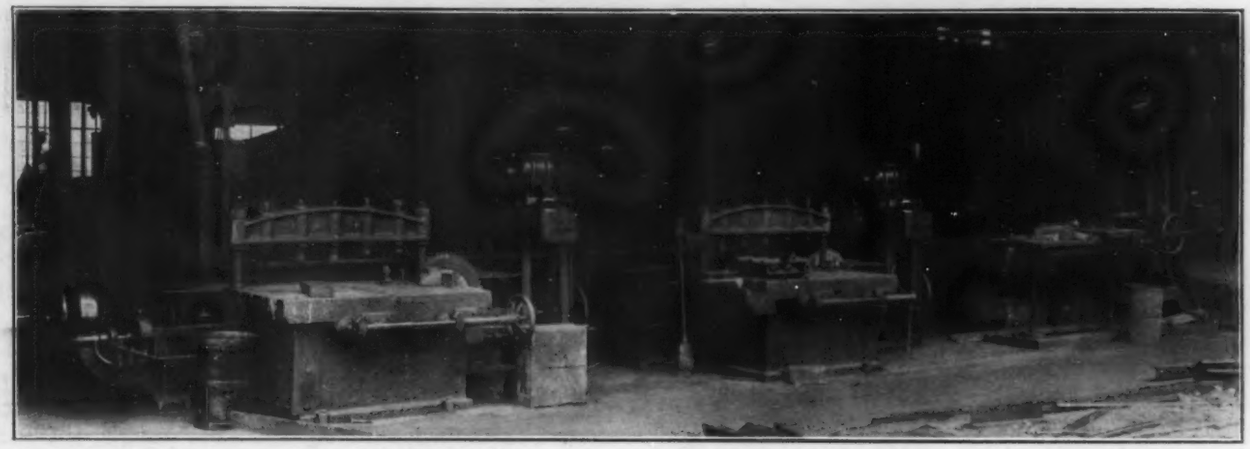
Amortisseur windings are installed in the pole faces to prevent hunting and permit starting as induction motors by the application of half-voltage to the collector rings. When the rotary locks in step if correct polarity is indicated by the direct current voltmeter the field break-up and reversing switch is closed in the upper position and full a. c. voltage applied to the machine, after which it is thrown on the d. c. bus.

Mechanical oscillators fitted to the armature shafts insure proper end play and over-speed governors arranged to trip out the d.c. circuit breaker upon fifteen per cent increase in speed prevent motor racing in the event of interruption of the a.c. supply.

Auxiliary Motor Generator Set.

A 4-bearing motor generator set consisting of a 75 h.p., 440 v., 900 r.p.m. induction motor flexibly coupled to a 50 kw., 250 v., d.c. generator is installed on the lower floor together with its own switchboard and is intended to carry small direct current loads at night as well as to help out in the event of damage to one of the rotaries.

An interesting feature of this set is the use of a pole-changing switch by which the a.c. motor may be operated at half speed and 125 volts direct current obtained by paralleling the shunt fields of the d.c. generator. This gives a spare source of excitation in the event of any accident to the exciter.



A.C. Motor Driven Cold Saws and Angle Iron Drill.

Electric Distribution System.

The electric distribution system is entirely underground and contains 7913 duct feet of three duct vitrified tile conduit connected by concrete manholes. There are three main duct lines of twelve ducts each leaving the power house and running north, south and east respectively and each terminating in a five by five manhole from which 3 in. Orangburg fibre conduit runs to the sub-distribution boards in the building.

No. 4/0 stranded lead-covered, paper-insulated cable for 1000 volt working pressure is used on all feeders, two conductor being used on d.c. and three conductor on a.c. feeders. Each feeder consists of at least two cables in multiple and porcelain pot heads with disconnecting links permit the isolation of any defective cable with only a momentary interruption to the service of the department affected.

The works are divided by 20th street into north and south districts and as far as possible this natural boundary line has been followed in the separation of the alternating and direct current distributions.

The south works consists mainly of machine shops and forms the direct current district while the north works is principally devoted to plate work and forms the alternating current district. There is however a certain amount of unavoidable overlap which is taken care of by one feeder running to each works and looped through all departments to provide for portable tools, etc.

There are twelve main feeders leaving the power house consisting of four direct current and six alternating current powers feeders and two alternating current lighting feeders, all of which are from 400 to 600 amp. capacity.

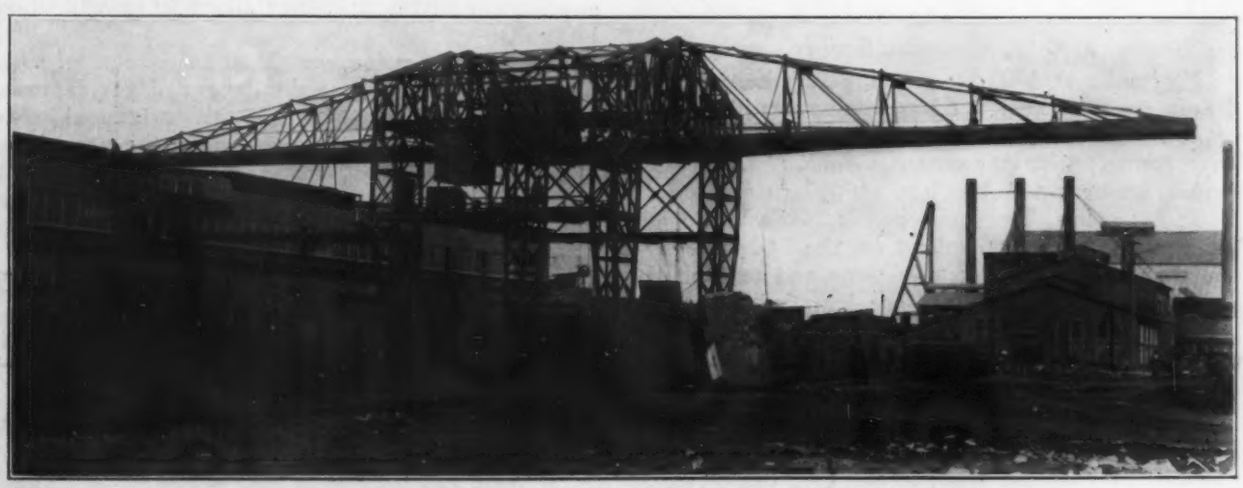
Each of the large departments is fed from an individual feeder metered at the main switchboard, but the small departments utilizing only a few motors are grouped to give a feeder of reasonable capacity. Each small department is connected to its feeder by a double pole contactor operated by push buttons in the power house enabling the load to be governed with great flexibility.

Sub Distribution Boards.

All underground cables terminate in six distribution boards installed just inside the building adjacent to each manhole and from which the various shop feeders run. Each feeder is limited to 200 amp. and fused with a 200 amp. code fuse. The sub-distribution boards are installed in sheet steel cabinets with glass doors and all those on the direct current system are provided with a totalizing ammeter and ground detector lamps.

Submarine Battery Charging Plant.

In a small sheet iron building located at the submarine building slips there is installed a 165 kw., three-bearing, motor generator set, consisting of a 250 h.p., 440 v., 900 r.p.m., induction motor direct connected to a 165 kw., d.c., shunt-wound, inter-pole generator.



Three-Phase Cantilever Crane Over Stock Pile.

This set is used for charging the storage batteries on the submarine boats and is designed to supply a current of 300 amperes continuously at any voltage from 200 to 330 and to supply 600 amperes for a period of two hours.

The government specifications call for several test discharges of the batteries under various loads and these discharges are made by weakening the field of the d.c. generator thus driving the induction motor above synchronism and returning alternating current to the system.

Salt Water Pumping System.

Salt water at 60 lb. pressure for yard sprinkling, lavatories and general service is supplied by two motor-driven two-stage centrifugal pumps installed in a steel pump house on the wharf. These pumps also supply circulating water for the air compressor water jackets, etc., and in order to prevent possible interruption to this important service each pump is operated from a separate feeder. In case of fire the pumps may be operated in series, giving 120 lb. pressure.

Planer with Cutter Head Direct-Connected to 3600 r.p.m. Induction Motor.

1700 lb. Hydraulic Service.

Hydraulic at 1700 lb. pressure for the operation of bull riveters, keel benders, elevators, jib cranes, etc., is furnished by a triplex hydraulic plunger pump direct connected to a constant torque two speed induction motor rated 150 h.p. at 600 r.p.m. and 75 h.p. at 300 r.p.m. The low speed is used at night and during times of light demand on the hydraulic system, thus saving considerable wear and tear on the gearing, etc. Accumulators are installed at several points on the hydraulic system and help to steady the load and eliminate the too frequent operation of the automatic by-pass on the pump.

Low Pressure Air Service.

Low pressure air at from 10 oz. to 2 lb. per sq. in. is required for cupola blast, forges, etc., but owing to the heavy losses in transmission from a central plant individually driven electric blowers have been installed in each department requiring this service.

High Pressure Steam.

Two boilers furnish steam to the forge department hammers as well as for steaming tanks on fuel oil carrying steamers.

These boilers are equipped for oil burning but owing to the large amount of refuse from the various wood working shops shaving burning equipment is also installed.

Floating Dry Docks.

The two floating pontoon dry docks at the Potrero plant are now being converted to electric drive. Each dock is equipped with eight bucket pumps, the four on each pontoon being at present geared to a Corliss engine.

A 50 h.p., 440 v., 3-phase, variable speed motor, will be belted to the flywheel of each engine without in any way interfering with the operation of the docks by steam should it ever be necessary.

An underground 480 volt, 3-phase, feeder runs direct from the power house to the distribution panel between the two docks, from which point flexible cables are run to the pontoons permitting the necessary vertical movement of the docks.

Electric Welding.

In the repair of marine boilers and defective steel castings extensive use is made of the Slavanioff process of electric arc welding. Two electric welding plants are in use, one a portable motor generator set mounted on a truck for use ashore and the other a gasoline engine driven plant installed on a barge, which may be towed alongside any work afloat. A small air compressor is also installed on the barge to furnish air for chipping and caulking.

Ship Lighting System.

The choice of a distribution system for the supply of light and power to the various ships under repair at the plant presented quite a problem owing to the heavy load and the comparatively great distance from the substation.

A second transformation of power at the docks was for many reasons undesirable and owing to the temporary character of the wiring and the rough usage encountered it was not thought advisable to employ any system having a voltage strain to ground of over 120 volts.

The complication, weight and first cost of single-phase motors as well as the danger of gas explosions in oil tanks due to flashing at the centrifugal switching devices usually employed, made the use of polyphase motors almost imperative so that a 208/120 volt, 3-phase, 4-wire system with 208 volts between phases and 120 volts between phases and grounded neutral was adopted for this service.

Many portable motors are used to drive ventilating blowers, emery wheels, pipe cutters, cylinder boring bars, etc., and their operation from the lighting system enables both light and power to be carried aboard ship on one 4-conductor cable.

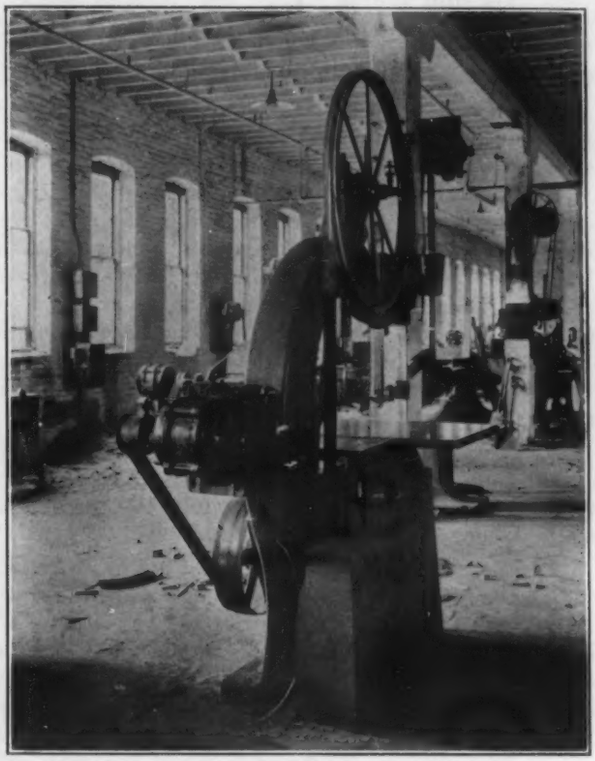
Although most ships are wired for 110 volts, quite a few foreign built vessels operate their lamps at 60, 80 or 90 volts and the use of alternating current enables

these voltages to be readily derived from the lighting system by means of auto transformers.

In order that the system may be kept balanced the phases are designated red, white and blue and all connections at the 50 different distribution points along the various wharves are plainly designated by colored bands.

The dock switchboard is equipped with ammeters and pilot lamps colored to correspond and a 200 amp. current transformer in the neutral operates a bell and signal lamp through a relay upon the occurrence of any unbalance in excess of the relay setting. When the neutral relay operates the attendant has only to glance at his ammeters and for example should he find the "red" high and the "white" low he merely transfers the nearest "red" ship to "white" to restore the balance.

Multiple 110 volt a.c. arcs are used for the general illumination of cargo holds, etc., supplemented by portable lamps in steam tight globes for each workman.



Induction Motor Driven Band Saw with Patented Starting Switch.

Plant Lighting System.

The various shops are lighted by a sort of three-wire system derived from two phases and the neutral of the ship lighting system. The shop lighting load is comparatively light and as most of the departments were already wired on the three-wire system the expense of adding the fourth wire was unwarranted as no power was desired on these circuits. The various three-wire circuits are balanced between phases at the power house distribution.

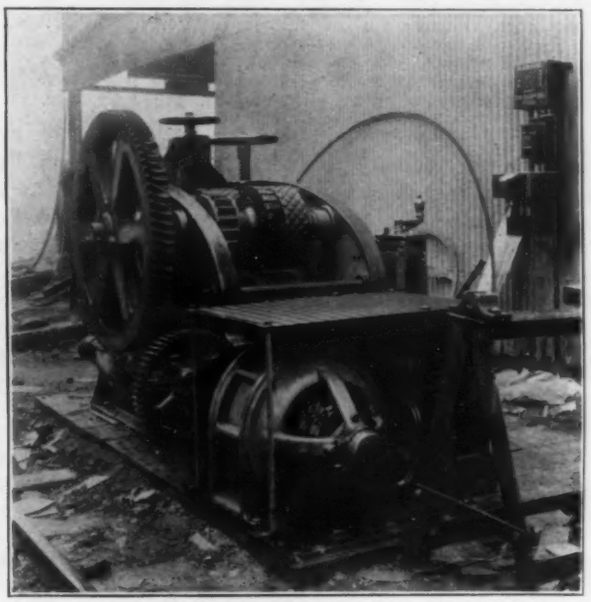
The general illumination of the plant is by 110 volt, 250 watt, Mazda lamps in enamelled steel reflectors except in a few of the larger buildings where long burning multiple a.c. flame arcs are on trial.

The use of local lighting is discouraged as far as possible by the provision of adequate general illumination, intensities as high as three foot-candles being obtained in certain departments, but a receptacle is installed on each machine tool to which a portable light may be connected for boring and other inside work.

All lighting is supplied at 110 volt a.c. except portable lights on machine tools where 230 volt d.c. is already run and where the duplication of circuits would be inadvisable on account of complication. Non-interchangeable plugs are standardized for 110 and 220 volt throughout the plant and the use of locking guards prevents interchange of lamps by unauthorized persons. In a very few locations in remote corners of the plant reached only by the 208/120 volt, 3 wire system, small amounts of power are furnished by 220 volt single-phase motors.

Direct Current District.

Direct current at 230 volts is used for power in all machine shops, the planing mill and the older



Angle Iron Planer, Showing Construction for Variable Speed A.C. Motor.

traveling cranes throughout the plant. The superior speed control available with direct current motors renders them best suited for machine shop service and contrary to the usual opinion the repairs have been found to be no greater than on small induction motors.

About 500 d.c. motors are now in operation and when the work of changing the machine shops to individual drive is completed this number will probably not exceed 600 as all extensions other than machine shops are being made alternating current.

When shops are changed to alternating current the old d.c. motors are overhauled and used for extensions in the d.c. district, obviating the heavy loss of equipment usually caused by this change.

Carbon compression starting rheostats are in use on most of the motors but on all new work series contactor self-starters are being used and result in a great saving both in time and cartridge fuse renewals.

In order to show the great diversity factor incidental to the individual drive of machine tools data on a few d.c. feeders is given below:

No. 17—119 motors—1350 h.p.—600 kw. hr. per 8 hr. day.
No. 19—120 motors—1175 h.p.—750 kw.-hr. per 8 hr. day.
No. 21— 37 motors— 245 h.p.—400 kw.-hr. per 8 hr. day.
No. 23— 72 motors— 618 h.p.—425 kw.-hr. per 8 hr. day.

Feeder No. 21 is mainly composed of motors driving line shafts while the others are composed of individually driven tools exclusively and the difference in diversity factor is quite marked.

Alternating Current District.

Alternating current at 480 volt, 3-phase, is used in the boiler, forge, pattern and shipyard departments as well as in all pumping plants and the later traveling cranes. Individually driven tools are used without exception in the a.c. district, and although the introduction of alternating current into the plant occurred hardly two years ago the connected load already exceeds that on the d.c. system while the kilowatt hour consumption is three times as great.

Only about 125 a.c. motors are installed as yet but the number is rapidly increasing and the larger average size explains the high kilowatt hour consumption. Data on a few a.c. feeders is given below:

No. 1—65 motors—729 h.p.—450 kw. hr. per 8 hr. day.
No. 9—13 motors—112 h.p.— 50 kw. hr. per 8 hr. day.
No. 11—14 motors— 54 h.p.— 25 kw. hr. per 8 hr. day.

The department supplied by feeder No. 11 was formerly operated by a 25 h.p. motor driving a line shaft and the consumption averaged 150 kw. hr. per day, whereas now, with 14 motors totaling 54 h.p. the consumption is only 25 kw. hr. per day. This of course is an unusual showing but it illustrates only one of the many advantages of individual drive, among which are better light due to the absence of overhead gear and the ability to locate tools to best advantage without regard to the position of shafting.

A.C. Controlling Devices.

Squirrel cage motors of 5 h.p. and under are started by a double throw interlocking switch protected by both starting and running fuses. This switch was specially designed for iron works use and is patented and manufactured by the Union Iron Works Company.

Squirrel cage motors of 7½ h.p. and over are equipped with standard two-point starting compensators with cartridge fuses for starting protection and overload relays acting on the no voltage release for running protection.

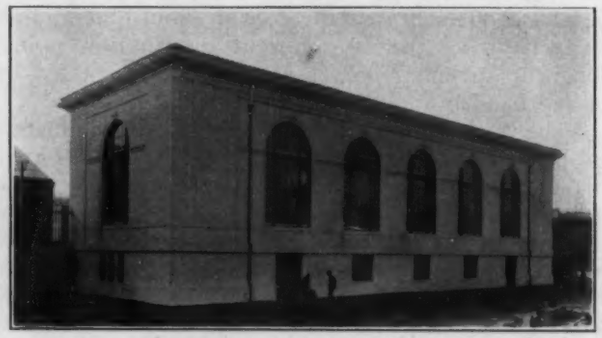
Wound rotor variable speed motors of all sizes are equipped with reversing controllers and iron grid resistance and are protected by oil switches with both overload and no voltage release in addition to cartridge fuses.

Inspection and Maintenance.

A very complete system of records of all motor trouble coupled with systematic and regular inspection have reduced the maintenance cost to a very small figure and once the reconstruction of the plant is complete and temporary work eliminated the delays due to motor trouble will be negligible.

All electrical trouble is reported to the trouble operator who sends out the repair men, issues spare parts and keeps in touch with the entire power system.

All motors brought to the shop for repairs are completely overhauled, both electrically and mechanically, before being returned to service, and the series of tests given is so rigid that a motor rarely returns for repairs after passing the tester.



Rear View of Power House.

Acknowledgment.

The publication of this article was made possible through the courtesy of Mr. John A. McGregor, president Union Iron Works Co.

POWER PLANTS OPERATING ON NATIONAL FOREST RESERVES.

The records of the district office of the forest service in Odgen show that thirty-three hydroelectric power plants are operating in district No. 4 on national forest land, some under permit and some in alleged trespass now involved in litigation pending in the Circuit Court of Appeals. District No. 4 comprises the State of Idaho south of the Salmon River, all of the States of Nevada and Utah, Arizona, north of the Grand Canyon of the Colorado, and Southwestern Wyoming. These power plants have an installed capacity of 28,600 h.p.

The total number of power plants in the district, including those on private land, as well as those on the national forests, is approximately 100, having an installed capacity of 176,000 h.p.

Permits to occupy national forest land for the purpose of constructing, maintaining and operating water power projects within this district are handled by the district office of Ogden. Two distinct kinds of permits are issued. A preliminary permit will allow the occupancy of forest land usually for a period of from one to two years, for the purpose of securing data and estimates of the proposed project, and for such construction as may be necessary to preserve water appropriations within that period. A final permit allows the complete construction, maintenance and operation of the project usually for a period of fifty years, and is issued upon the receipt of the data secured by the applicant during the period of the preliminary permit.

No rental charges for the use of national forest land is made for water power projects of a capacity of 100 h.p. or less; for projects of municipal corporations for municipal purposes; for projects where the power is used for irrigation or temporary construction of power works.

A nominal rental charge is made for all other power projects. It is based on the capacity of the site and is fixed at rates varying from 10 cents per h.p. capacity for the first year to $1.00 for the tenth year, subject to a revision at the end of each ten-year period.

THE STRAIGHT LINE DIAGRAM.

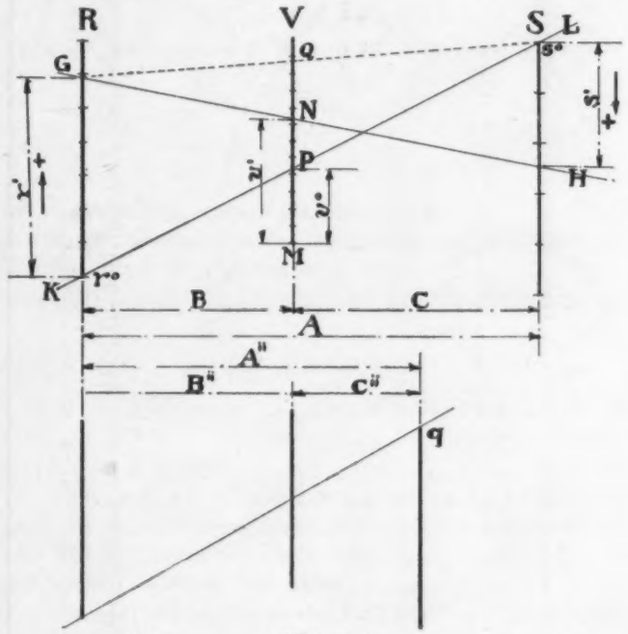
BY J. P. ZIPF.

The straight line diagram offers a quick means of finding the value of any term in either equation

(1)....$v = Cr^m s^n$

(2)....$v = C' r^t Q^p$...C and C' being constants if the value of two of the other terms in either equation are known. This is accomplished by drawing a straight line through the known values, intersecting the "unknown" scale at a point, which by its location and graduation, fulfills the above equation.

Arrange three parallel lines, R. S and V, choosing a suitable scale for the graduation of one of these lines, say V. Then "v" units along V will represent v, although the same distance laid off along R or S may not represent either r or s. The positive direction along R is upward and along S downward, with the position of r^o, s^o anywhere along their respective lines. A line (KL) is drawn through r^o, s^o, intersecting V at P and $PM = v^o$. Any other line (GH) drawn through r', s' intersects V at N and $NM = v'$. Then from the figure (Fig. 1)



(Fig. 1)

$$NM = v' = MP + PN$$
$$v' = MP + PQ - QN$$
$$v' = v^\circ + PQ - QN$$

Also $PQ : r' :: C : A$, $PQ = C r'/A$

$QN : s' :: B : A$, $QN = B s'/A$.

$$(3)....v' = v^\circ + \frac{C r'}{A} - \frac{B s'}{A}.$$

Hence any equation which can be written in the form of (3) can also be laid out in the form of a straight line diagram.

(1) and (2) can be written in logarithmic form.

(4)....$\log v = \log C + m \log r + n \log s$

(5)....$\log v = \log C' + t \log r + p \log Q$,

which are in the form of (3), R. S and V, being divided logorithmically but with the positive direction along S and Q reversed.

Graphically the diagram is very easy to construct. After R and S are laid down and arbitrarily graduated, values of s are computed for $r = 10$, $v = v'$, and $r = 100$, $v = v'$, the position of V being determined by the intersection of these two lines, and parallel to R and S. The position of $v = 10$, $v = 100$ are found for selected values of r and unknown values of s, thus permitting the graduation of V.

By this graphical method no account is taken of the ratios $\frac{C}{A}$ and $\frac{B}{A}$, these coming what they will with the arbitrarily graduated R and S.

It is interesting to note the relation existing between the several parts of the diagram. Referring to (3) $\frac{C}{A}$ and $\frac{B}{A}$ are geometrical properties of the figure.

$$C + B = A \text{ and } C = A - B$$

$$(6)....\frac{A}{C} = \frac{A}{A - B}$$

B and C may be chosen to give any convenient ratio.

Comparing (3) and (4)

$$\frac{C r'}{A} = m \log r \text{ and } \frac{B s'}{A} = n \log s$$

$$(7)....r' = \frac{A}{C} m \log^* r.$$

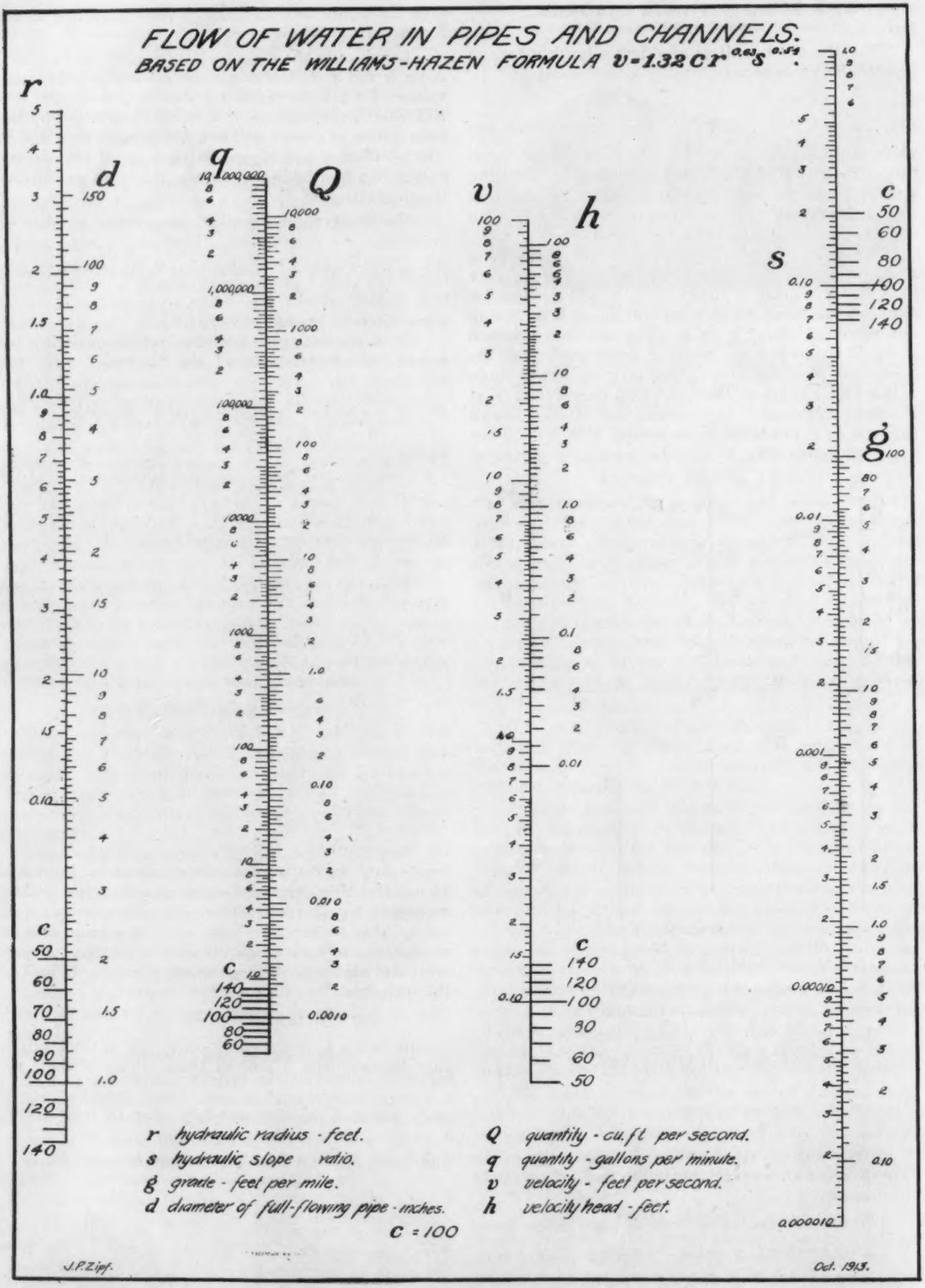
$$(8)....s' = \frac{A}{B} n \log^* s.$$

$\log^* r$ and $\log^* s$ have a special meaning, borrowed from (3). If in (4) the distance $v = 10$ to $v = 100$ be measured by D centimeters (or inches) this scale serves also to measure $\log r$ and $\log s$ in a manner similar to the logarithmically divided scale of a slide rule, and algebraic addition along a line so divided of the quantities.

$$\log C + m \log r + n \log s$$

results in $\log v$ on the same scale; but in the straight line diagram with a unit of D cm. along V there results along R a corresponding unit of $\frac{A}{C} m$ D cm., and along S, $\frac{(A \text{ n D})}{B}$ cm. embrace the same unit.

Then if the position of R, S and V be chosen, which is equivalent to choosing B and C, the unit distances to be graduated along R and S are as above, but before V can be graduated the position of v^o is found by connecting r^o, s^o, as in the figure, r^o, s^o, being


FLOW OF WATER IN PIPES AND CHANNELS.
BASED ON THE WILLIAMS-HAZEN FORMULA v = 1.32 C r^0.63 s^0.54
r
d
q
Q
v
h
s
c
g
r hydraulic radius - feet.
s hydraulic slope ratio.
g grade - feet per mile.
d diameter of full-flowing pipe - inches.
Q quantity - cu. ft per second.
q quantity - gallons per minute.
v velocity - feet per second.
h velocity head - feet.
C = 100
J.P. Zipf.
Oct. 1913.

(Fig. 2.)

the points $r = 1, s = 1$, since $\log 1 = 0$. $v^0 = \log C$ gives a starting point for the graduation of V.

In order to add (2) to the diagram, we have in a manner similar to (3)

$$(9)\ldots. v'' = v''^0 + \frac{C'' r''}{A''} - \frac{B'' s''}{A''}$$

and equating corresponding terms of (9) and (5)

$$\frac{C'' r''}{A''} = t \log^* r.$$

$$(10)\ldots. r'' = \frac{A''}{C''} t \log^* r.$$

For the same numerical value of r (7) = (10)

$$\frac{A}{C} m \log^* r = \frac{A''}{C''} t \log^* r.$$

$$(11)\ldots. \frac{A''}{C''} = \frac{A m}{Ct} = \frac{A''}{A''-B''}$$

$$(12)\ldots. \text{calling } \frac{Am}{Ct} = K, \text{ and } B'' = B, \text{ from the figure.}$$

$$(13)\ldots. A'' = \frac{K}{K-1} B.$$

which locates the scale for value of Q.

In the same manner as before the unit distance along Q is $-\left(\frac{A''}{B''} p D\right)$ cm. and the logarithmic graduation of Q is started at $v^{0''} = \log C'$.

If in addition to (1) and (2) we have a relation that

$$(14)\ldots\ldots r = c w$$

or $(15)\ldots. r - c w^1$ a scale for w can be substituted for that of r, or what is the more flexible arrangement, the line is graduated for values of r on one side, and for values of w on the other.

From (14) $\log^* r = \log^* c + \log^* w$. The position of w^0 therefore differs from that of r^0 by the distance $\log^* c$, on the same unit scale as the logarithmic division of r.

From (15) $\log^* r = \log^* c + 1 \log^* w$. The term $\log^* c$ has the same meaning as before and from what follows (7) $w' = \frac{1}{1} \frac{C}{(A m D)}$ cm. where w' is the unit distance graduated logarithmically to form the scale for W.

The constant C of (1) may have a number of values, as it does in the case of the maximum bending moment of a simple beam, where $BM = cWL$, W being the total load on the beam and L the distance between supports ($c = \frac{1}{2}, \frac{1}{4}, \frac{1}{8}$ or 1), but only one straight line diagram can be constructed for the equation. If the diagram is constructed for C_1, values of v for C_n will be proportional to the values of v as read from the diagram, the proportional ratio being

$$(18)\ldots. \frac{C_m}{C_1} \text{ or } \frac{C_1}{C_n}$$

If in (1) v is unknown the direct ratio is used, but if s is the unknown the inverse ratio is used. This is easily seen if the equation is written with the unknown on the left hand side, the known terms then being on the right.

To save subsequent multiplication by the factor $\frac{C_n}{C_1}$ the scale of V might have several graduations applied to it, so that readings could be made directly by referring to the proper scale. With the logarithmic graduation of the scales of the diagram, the variation of the constant is very easily controlled by the shifting of the scale, or by the addition of the quantity $\log^* \frac{C_n}{C_1}$; the latter being the most expedient, for $\log^* \frac{C_n}{C_1}$ is very easily added to the point of intersection of the "straight line" and the scale by means of a pair of dividers, and the corrected scale reading obtained.

If all the exponents of (1) and (2) are unity, logarithmic graduation is not necessary, a simple arithmetical scale being sufficient. This is evident from (3). A logarithmic division of the scales would be useful if a diagram having the same relative precision throughout its range is desired.

Equations (1) and (2) have been chosen with the idea of illustrating this article. The Williams-Hazen formula for the flow of water in pipes and channels is (Fig. 2.)

$$(19)\ldots. v = 1.32 C r^{0.63} s^{0.54}$$

v = velocity of flow in channel; ft. per second.

C = a constant ranging in value from 50 to 140, depending on the surface of the channel. It is here taken as 100.

r = hydraulic radius in ft. $= \frac{\text{Area,}}{\text{Wetted perimeter}}$

s = slope of channel; a ratio.

Choosing B as 18 cm., and C as 12 cm., A is then 30 cm.

The distance $v = 1$ to $v = 10$ was taken as 10 cm. = D.

In the reduced cut, the several parts will be in this proportion.

From (7) the distance $r = 1$ to $r = 10 = \frac{30 \times 0.63 \times 10}{12}$

$= 15.75$ cm.

From (8) the similar distance on S is $\frac{30 \times 0.54 \times 10}{18}$

$= 9.00$ c. m.

The R and S scales are located and graduated, starting from convenient positions of r^o and s^o. On the "v" scale, log 1.32C = log 132 from which the graduation of V is started.

If the conduit is a pipe flowing full, $r = \frac{d}{4}$ where d is the diameter in feet; or $r = \frac{d'}{48}$, d′ being the same dimension in inches, and from (14) $r^o = d^o + \log 48$, or d^o is at 48 on the scale of R. The line is then graduated on one side for values of r and for values of d′ on the other.

(21)....$v = 183.4\, d'^{-3}\, Q$, which is similar to (2).

Q = quantity in cu. ft. per second.

From (12) $K = \frac{30}{12} \times \frac{0.63}{2.00} = -0.7875.$

$$K - 1 = -1.7875$$

Hence $A'' = \frac{-0.7875}{-1.7875} \times 18 = 7.93$ cm.

The distance Q = 1 to Q = 10 is $-\frac{7.93 \times 1 \times 10}{18}$ = 4.4 cm.

The — sign here indicates that the graduation of Q increase upward, since C″ is also negative.

The other substitute scales are added from well known relations, and need no explanation.

The colored prisms to be used in the novel and striking scheme of night illuminations of the Panama Pacific exhibit palaces are of fine cut glass made in Austria by a process not followed elsewhere. These prisms, to be known as jewels, are patiently hand tooled in the homes of artisans.

WHITE RIVER ELECTRIC SIGN.

The White River hydroelectric station of the Puget Sound Traction, Light and Power Company is located at Dieringer, twenty-eight miles from Seattle and thirteen miles from Tacoma, alongside one of the main traveled country roads between Seattle and Tacoma, and in plain view of the passing transcontinental trains of the Northern Pacific, Great Northern, Chicago, Milwaukee and St. Paul, Oregon-Washington R. R. & N. Company (Union Pacific), Southern Pacific and the Burlington Route, as well as the Seattle-Tacoma interurban trains, and can readily be seen from the Pacific highway.

It was thought that considerable advertising value would be derived from an electric sign on top of the station. In July, 1912, suggestions were requested from the employes of the company for a suitable design for such a sign. From the many designs submitted, one by W. N. Gordanier, superintendent of the Electron power plant, was selected. The original arrangement of the names of the towns was in geographical order from south to north, reading "Tacoma-Seattle-Everett-Bellingham." Mr. A. W. Leonard suggested arranging the names of the towns in geographical order from north to south, so that the first letter of each city would spell the word "Best" upon flashing out all of the other letters in the name of each city,, and finally after the flashing operation leaving the sign to read "Reliable Power"—"Best Light Service." The letters in these words are in red, and the remaining letters in each city name come on by cities until the names of the cities are spelled out in full. The waterfall, as well as the boiling effect of the water at the bottom of the falls, are very realistic and beautiful.

The sign is 200 feet long and 54 feet high, contains 96 letters (the largest of which is 8 feet high), and is supported by eighteen tons of steel frame work. It carries 4000 30-watt carbon lamps and requires 120 kilowatts for its operation.

White River Sign—Puget Sound Traction, Light & Power Co.

FACTORY LIGHTING AND WORKMEN'S COMPENSATION.

The State of California Workmen's Compensation, Insurance and Safety Act (Boynton) which becomes effective January 1, 1914, contains clauses of especial interest to the electrical interests and closer familiarity with the requirements of the act may open up new channels for improved standards, together with the remodeling of existing lighting installations.

In the past, appeal for better lighting has been made to the employing interests upon the grounds that it meant increased output, better workmanship and a minimum spoilage. There now enters another and perhaps stronger factor to be considered, viz: the safety or protection of employes.

In the East, poor artificial illumination of workshops has been construed by the courts as contributory negligence on the part of employers where such poor illumination existed at the time an accident occurred.

In the Boynton Act (Chapter 176 of the Laws of 1913), no specific mention is made of good lighting as a factor of safety, but sub-section 9 of section 52 reads:

The terms "safety device" and "safeguard" shall be given a broad interpretation so as to include any practicable method of mitigating or preventing a specific danger.

It is probable that inadequate, inefficient or otherwise unscientific lighting constitutes a specific danger.

The employers' liability to provide reasonably safe employment is very definitely stated in section 52, which is as follows:

Every employer shall furnish employment which shall be safe for the employes therein and shall furnish a place of employment which shall be safe for employes therein, and shall furnish and use such safety devices and safeguards and shall adopt and use such practices, means, methods, operations and processes as are reasonably adequate to render such employment safe, and shall do every other thing reasonably necessary to protect the life and safety of such employes.

It is somewhat early, although not too early, to anticipate just what the commission will order as regards illumination standards made by them under sub-sections 1 and 2, of section 57. To date, no rules have been published, although liability of employers under this Act commences upon the day on which the Act goes into effect.

Early in this year, the committee of the Illuminating Engineering Society on factory lighting, made certain recommendations to the New York Legislature bearing upon factory lighting and as a result, Bill No. 26 of the laws of the State of New York, entitled, "An Act to amend the labor law, in relation to the protection of employes operating machinery, dust creating machinery and the lighting of factories and workrooms," was signed by the governor April 17, 1913.

The section of the bill which relates particularly to the lighting of factories, passageways and workrooms, is as follows:

All passageways and other portions of a factory and all moving parts of machinery which are not so guarded as to prevent accidents, where, on or about which persons work or pass or may have to work or pass in emergencies shall be kept properly and sufficiently lighted during working hours. The halls and stairs leading to the workroom shall be properly and adequately lighted, and a proper and adequate light shall be kept burning by the owner or lessee in the public hallways near the stairs, upon the entrance door and upon the other floors on every work day in the year, from the time when the building is open for use until the time it is closed in the evening, except at times when the influx of natural light shall make artificial light unnecessary. Such lights shall be so arranged as to insure their reliable operation when through accident or other cause the regular factory lighting is extinguished.

All workrooms shall be properly and adequately lighted during working hours. Artificial illuminants in every workroom shall be installed, arranged and used so that the light furnished will at all times be sufficient and adequate for work carried on therein, and so as to prevent unnecessary strain on the vision or glare in the eyes of the workers. The industrial board may make rules and regulations to provide for adequate and sufficient natural and artificial lighting facilities in all factories.

It is not to be expected that the Industrial Accident Commission of the State of California will draft rules any less complete and if such be the case, then it is necessary that all interested central station salesmen, engineers, contractors and supply salesmen, should make an early and special study of this important subject of factory lighting for the narrowest construction which can be placed upon the Act shows that it is necessary that all factories be lighted properly and in accordance with the most advanced principles of scientific illumination.

Considerable educational effort is essential, for much has to be accomplished in a short time. The requirements are revolutionary. It has been the practice in the majority of installations to give the least possible attention to this subject of correct lighting and only a salesman of factory lighting reflectors, or an illuminating engineer, know just how difficult it is to instil into the minds of employers the necessity for adequate lighting equipment notwithstanding the demonstrable fact that "it pays." Pays because of a possible increased output, reduced spoilage, improved product, and the reduction of accident risks to a minimum.

Is the industry prepared to properly cope with the condition? It will certainly pay us to take inventory not only of stocks but of our knowledge and take whatever steps are necessary to remedy the shortage in either, for business flows to the firm that can haudle it and prospects to the man who knows how.

Increased production of natural gas in California during the year 1912 was most marked. The total production as estimated by E. W. Parker of the United States Geological Survey was 9,354,428,000 cubic feet, value at $1,747,379, compared with 6,389,820,000 cubic feet, valued at $800,714, in 1911. The larger portion of the natural gas produced in California is consumed in the industries, the estimated quantity in 1912 being 8,379,632,000 cubic feet. Only 974,796,000 cubic feet was consumed for domestic purposes, but these figures are almost double those for 1911, the number of domestic consumers having increased from 10,598 in 1911 to 18,171 in 1912.

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Technical Journal Service

Jones dropped back into his chair wearily, and the sigh that escaped was one of defeat. It was bitter too, for reliance had been placed in him to complete the project; he had gone into the work cheerfully and with confidence, and now—nothing, that's all, for his mind refused to think, although he seemed to know somehow that he was defeated, and the knowledge stunned him.

The problem to be worked out had taken all his time for months past. New and unique methods had to be tried out, and now at the critical time, invention failed him and the necessary solution would not come. He had tried all the regular avenues of relief but always with the same despairing results; and then the Morris chair engulfed him, nature came to the rescue and he was asleep.

* * * * * *

From the table and out across the room floated a dagger. It was unreasonable, but somehow Jones was not afraid. Cross-hilted it seemed to suggest salvation and with curiosity stretched to the point of impatience he watched its approach. It came, waited, and Jones understood that his part was to follow. How far? Just across to the corner of his study where lay an accumulation of technical mail. Jones stooped, and the act awakened him, causing him at the same time to involuntarily sweep his hand across the corner of his study table whereon lay a paper knife, a cross-hilted affair he had brought from Old Mexico, and it fell in the corner, just where Jones' dream had broken off.

It was too much of a coincidence. Picking up the first magazine which happened to be a copy of the Journal of Electricity a month old, Jones tore off the wrapper and the first thing he lighted upon was an article describing how a fellow engineer had solved an exactly similar problem elsewhere. An article given in a spirit of greatness which claims no property in truth and which realizes that we are made for co-operation; that we gain good by giving it.

"Just one month of worry might have been saved," soliloquized Jones, "had I but had the forethought to take advantage of the engineering service for which I paid and which incidentally cost so little. For the small sum of five cents weekly I have had the privilege of consulting the master minds of this science, the leading men of the day, and did not take advantage of it."

Then Jones made a resolution, and do you wonder why it is that he is now a regular reader?

Diversity Factor

Some terms encourage investigation but others more formidable in appearance are often dismissed from thought and so become shrouded with mystery. A vague term such as "depreciation," is bewildering to the uninitiated, but a term such as "diversity factor" which merely expresses the ratio of two factors should certainly be capable of simple explanation.

It is possible for a restaurant having a seating capacity of only one hundred, to serve no less than five hundred people at each meal. The reason for this is

self-evident. All people do not eat at the same hour. Waiters to serve one hundred are sufficient for all. It is also true that the restaurant keeper is able to estimate with a degree of accuracy the quantity of food he must supply. Although the appetites of patrons vary continually the estimates made are by no means guess work, as these variations, under the law of averages, generally neutralize each other. Usually in the summer seasons business is not so good because less food is required and although more people may be served at lunch each day, less is eaten than for the late dinner, and so this meal becomes the most profitable. Illustrations might be multiplied, but enough has been mentioned to bring out the factors which enter into a consideration of this question of diversity factor.

With a limited seating capacity the central station is enabled to literally feed the five thousand with but five barley loaves and two small fishes. From the viewpoint of low price due to the saving in service costs this is advantageous to the consumer, for among a group of customers served from one transformer or bank of transformers there will be a difference both as regards the time when used, hours use, and proportion of individual connected load (or more correctly, of individual maximum demand), used. This diversity of demand permits the installation of a much smaller transformer capacity than would be necessary if the maximum demand of each customer occurred at the same time. The same is true of generating equipment as well as distribution system, and this diversity factor which permits more than one customer to be served from the same equipment results in a saving in investment which, together with other factors, permits a charge for electric service which places it within reach of all.

The capacity of every central station generating equipment is less than the total individual maximum demands of all customers or even the combined maximum demands of the different classes of customers. All do not demand power from the company at the same time. For example, the business and commercial districts will during the winter months make their maximum demand for light at about 4 and 5:30 p. m., and the residence lighting load will begin to increase at about that time and reach its maximum at about 7 p. m. The "appetite" of each customer for light also varies. Tonight one house entertains and uses more light, tomorrow another, and so on.

In central station practice the term "diversity factor" is used to express the relation between the simultaneous demand of all individual customers and the sum of the maximum demands made by them; the sum of the maximum demands of the customers, no matter at what time they occur, divided into the simultaneous greatest maximum demand at the generating station or sub-station, expressed in per cent.

Similarly, the diversity factor of an installation is the sum of the maximum demands of the various units of which it is comprised divided into the greatest maximum demand of the entire installation and expressed in per cent.

The latter is easily calculated, but the central station diversity factor is a more complicated though interesting study. One too, which will amply repay considerable time and trouble spent in its consideration because of ts important bearing upon the cost of service.

Analysis of diversity factor is of importance in determining the investment required in the various parts of the distribution system for each kilowatt of maximum demand and hence the amount of the fixed charges which should be made to each customer.

Machine Shop Electrification

An article describing the power equipment of the Union Iron Works Company in this issue forms an interesting study of construction methods, and explains the conditions responsible for the radical changes made and the ideas adopted. The author, the company's electrical engineer, describes the reconstruction due to the rapid growth of business and the increase in the efficiency of present day machinery and methods rendering those of yesterday obsolete, though not outworn.

A progressive company must keep pace with progress.

The article is strong technically and should prove of value to all our readers. It is not surprising to learn that engineers visiting this plant are invariably astonished at the rapid advance which has been made in machine shop electrification as evidenced in this installation, and fully described in this article.

A careful study of the requirements of this plant and the reasons leading up to the adoption of individual electric drive and central station power service would equip the central station power salesman with many arguments which would contribute materially to his success in closing contracts for new business of this nature.

In such a large plant the many and varied application of power to ship-building and repair work, none of which pull power continuously from the supply system, creates a great diversity of demand, the greatest call on the power company at any one period being much less than the sum of the individual requirement of each machine: In this plant, this diversity factor—the ratio of the sum of the maximum power demands of the various units comprising this system to the maximum demand of the whole installation—approximates twenty per cent, which fact was fully utilized in the wiring design.

The electric motor and equipment salesman may also gather many valuable sales arguments in perusing this article. Every prospective customer wants the best—that which will most satisfactorily do the work—at the lowest possible cost, and if salesmen and specialists of all kinds would but take such opportunities as are here presented to acquire and perhaps file for future reference, working information of worth, sales would be much more easily made. When we know what is best for the prospect's requirements the better things are invariably sold.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Sylvester M. Baker, Macbeth, Evans Glass Company, is at Vancouver, B. C.

Frank Cook, representing the Ohio Brass Company, was at Salt Lake City recently.

R. D. Holabird, who has been visiting eastern factories, has returned to San Francisco.

Hugh Bargion is now manager of the Washington Electric Supply Company, Spokane, Wash.

J. W. Heap, Willits Water & Power Company, was at San Francisco last week on business.

G. R. G. Conway, chief engineer B. C. Electric Railway, Vancouver, B. C., is on a visit to New York.

H. W. Crozier, engineer with Sanderson & Porter, San Francisco office, is making an inspection trip to Idaho.

Chas. Corfield has been appointed chief electrician of the Utah Copper Company's plants in Utah and Arizona.

J. Presbey, Holophane Works of G. E. Company, is visiting cities in Northern California, Oregon and Washington.

Chas. Hoy, purchasing agent of the Reno Light & Power Company, Reno, Nev., was a visitor in San Francisco during the week.

H. C. Rice of the General Incandescent Lamp Works of G. E. Company, was at Salt Lake City on business during the past week.

R. B. Mateer, load factor builder, has returned to San Francisco from a tour of inspection of electric power plants in Southern California.

S. J. Keese, manager of the Westinghouse Electric & Manufacturing Company, Los Angeles, spent the latter part of the week in San Francisco.

H. T. Van Riper, representing the Hotpoint people, stopped off at Salt Lake City on his way to Denver on special business for his company.

T. M. Stateler, salesman with the Pacific States Electric Company recently returned from a two weeks' business trip through the southern part of the state.

Leo Brandenberger will in future have charge of the power section, Utah Power & Light Company, Salt Lake City, and **J. F. Derge** the lighting section.

Miles F. Steel, salesman with the Benjamin Electric Manufacturing Company, has returned to San Francisco from an extended trip through the Pacific Northwest.

Frank S. Easton returned to Vancouver, B. C., via Los Angeles and San Francisco. While east he attended the convention of the American Institute of Civil Engineers.

P. E. Overend, formerly with the Northern Electric & Manufacturing Company, Vancouver, B. C., has joined the sales department of the Pacific States Electric Company in Portland, Ore.

C. C. Hillis, general manager and treasurer, Electric Appliance Company, San Francisco, has left for an extended trip East. Mr. Hillis will attend the Jobbers' Convention at Hot Springs, Va.

E. J. Cochrane, chief efficiency electrical engineer with the Sydney Municipal Council, Sydney, Australia, is inspecting the various Pacific Coast power plants, having spent the past week in San Francisco and vicinity.

L. R. Jorgensen, engineer with F. G. Baum & Company, has returned to San Francisco from a trip made to Juneau, Alaska, in order to inspect the Jorgensen arched type dam installed by the Alaska-Gastineau Mining Company.

A. M. Hunt, consulting engineer and chairman of the paper's committee for the International Engineering Congress at San Francisco in 1915, will leave for an extended eastern trip next week in connection with the Congress work.

A. O. Boniface, special travelling agent for the Underwriters' Laboratories, is returning to Chicago by way of Portland and Seattle after a month's conference with various Pacific Coast manufacturers of approved and labelled goods.

J. Nadon has joined the sales force at the Westinghouse Electric & Manufacturing Company, San Francisco. Mr. Nadon is a graduate of the University of Nevada and also of the preparatory school of the Westinghouse Company at East Pittsburgh.

George Hoxie of New York, **C. L. Cory** of the State University at Berkeley and **C. W. Koiner** of Pasadena have been recommended by the public service committee of the city council of Los Angeles to make estimates of the amount of money needed for the completion of the power plants, and a distributing system required in connection with the aqueduct project.

MEETING NOTICES.

Jovian Electrical League of Southern California.

The regular meeting of the League was held at Christophers at 12 noon on November 12th, with Mr. Charles S. Walton in the chair. The meeting listened to two papers, one on "Are You Living and Making a Living?" by Reynold E. Blight, and "Electric Trux," by Harry W. Harrison.

Electrical Development and Jovian League—San Francisco.

The regular monthly business meeting was held Tuesday, October 11, 1913. Reports of committees and routine business was transacted. A nominating committee consisting of Messrs. F. Poss, S. Walton and P. B. Hyde was appointed to select candidates for the offices of president, vice-president, secretary-treasurer and two members of the executive committee and report at the December 9 business meeting.

Utah Electric Club.

At the regular luncheon of the Utah Electric Club at the Commercial Club last Thursday, plans for the winter's business and entertainment were discussed. Chester P. Cahoon, manager of the Progress Company of Murray, chairman for November, presided. Committees were appointed to arrange for socials, lectures and other forms of entertainments.

Mr. J. C. Jones, local manager of the Westinghouse Electric and Manufacturing Company, was elected chairman for January.

Oregon Society of Engineers.

The local Chapter of American Institute of Architects and the Oregon Society of Engineers held an informal luncheon at the Portland Commercial Club in honor of Mr. G. Alexander Wright of San Francisco, who addressed them on "Quantity Surveying."

The idea of "Quantity Surveying" is for the architects to definitely specify the quantity of each kind of material thereby placing the contractors all on the same basis instead of asking them to furnish enough material to conform to the specifications and drawings.

TRADE NOTES.

Mr. A. L. Bowen, consulting engineer, has moved his offices from 1026 Henry Building, to 810-811 Hoge Building, Seattle, Wash.

Mr. Thomas Morrin, consulting mechanical engineer, announces the removal of his offices from the Balboa Building to 547 Phelan Building, San Francisco.

The Steel City Electric Company, Pittsburg, Pa., announce the appointment of the Ohio Distributing Company, Hearst Building, San Francisco, as their sales representatives in the central western states.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION

An excellent paper was submitted at the last meeting by C. F. Butte, the main purpose of which was to suggest methods by which the membership could be increased and the Association made of more value to the members.

The paper was referred to a committee which was instructed to analyze Mr. Butte's paper more carefully and suggest whatever would be immediately practicable. The following suggestions were submitted by the secretary and later adopted:

1st. That a prize of $50.00 be offered to the man securing the greatest number of members during the next six months, commencing November 1st.

2nd. That a committee be appointed to study and report on the feasibility of a central buying point.

3rd. That a committee be appointed to study the possibilities of a central estimating quarters and a universal estimating scheme.

4th. That a committee be appointed to study and report on the advisability of gathering through the central office advance building information, which information is now paid for by each firm separately.

5th. That a committee be appointed to work out a delivery system. (It is suggested that a contract be made with a large teaming firm under which all deliveries could be made promptly and at a uniform charge, depending upon delivery.)

The above committees were appointed.

The report continues: You have the price and data book committee, which should be encouraged to continue this work by every member helping and sending out data that will be useful to other members.

With reference to stimulating interest in meetings, every member should consider himself a committee of one to obtain speakers for the meetings, and, in fact, bring up any live subject that would be of interest to the other members.

Too much cannot be said of the last paragraph of Mr. Butte's paper having reference to burying individuality.

Just think for a moment what a grand organization this would be if every member would cast aside any thought that would in any way be detrimental to the electrical contracting business as a whole. We are all here to make money, but at the same time I think that at the present time that by putting self first we are tearing down so fast that our progress is very slow.

A great deal depends on your secretary, but remember he is in the position of trying to guide you into the narrow lane which we call "success."

You are all pulling different ways, maybe not intentionally, but thoughtlessly—some by placing individuality above the general good, some by carelessness, some by greed, some by thoughlessness.

Let us stop for a minute and see what this means. It means dissatisfaction, and often dissolution, which means you must start all over again.

Now let us have the other side.

A successful association means satisfaction and progress. If your association were a success you would all be successful. Is the goal not worth working for?

Just realize that there is nothing we could not do if every man in this organization would think and do nothing that would be detrimental to the organization, would boost it every time he met a contractor who was not a member. Get the association talked about. Remember the little things the association does for you, and the time would not be long before you would have contractors trying to get in instead of having to seek them.

NEW CATALOGUES.

(Under this heading attention is directed to catalogues and bulletins representing the latest information upon the subjects treated. The latest developments are always in advance of the most up-to-date text books. Readers are urged to write direct to the publishers for these catalogues and bulletins which, unless otherwise stated, are available for free distribution.)

"Thyssen," entrainment vacuum pumps are fully described in Bulletin No. 15 issued by the C. H. Wheeler Manufacturing Company, Philadelphia, Pa.

"Mineral Production for 1912," compiled by E. S. Boalich, Statistician, California State Mining Bureau, is the title of Bulletin No. 65, the latest publication of that Bureau. Comparative data is given and also the mineral production by counties.

An envelope stuffer on industrial lighting fixtures has been issued by the Benjamin Electric Manufacturing Company, Rialto Building, San Francisco, which describes that company's line of reflector sockets, industrial clusters, mill clusters and gas and vapor-proof fixtures.

Gleason Tiebout Glass Company, New York, are taking advantage of the opportunity presented in introducing new lines of semi-indirect illuminating glassware, to invite the public to inspect same at their various show rooms. Complete catalogue is sent on request.

The baby sales stimulator sent out under the name of the National Miniature Mazdafier by the National Lamp Works of General Electric Company, Cleveland, Ohio, is devoted to National Mazda miniature lamps. If you are interested in the sale of miniature lamps you will find the "Mazdafier" a fresh monthly fund of clever sales ideas, novel window displays and new advertising helps, which will aid you in building up a profitable business in miniature lamps.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

The railroad commission issued a supplemental order in which it allowed the Tulare County Power Company to carry to completion its proposed issue of notes in the sum of $250,000.

A decision was rendered granting authority to the Reedley Telephone Company to issue $2,500 of stock.

The Southern Sierras Power Company was granted authority to renew $10,000 of promissory notes for the purchase of property of the Lytle Creek Power Company.

The United Light & Power Company was granted authority to issue a note in the sum of $6000.

A decision was rendered granting authority to the Pacific Telephone & Telegraph Company to issue $3,000,000 of bonds. The proceeds will be devoted to retiring $850,000 of underlying bonds and to improvements in the company's plant.

The San Diego & Arizona Railway Company applied for authority to issue $15,000,000 of bonds for the construction of a line of railway from the city of San Diego to Yuma, Arizona.

A decision was rendered granting authority to the Pacific Light & Power Corporation to issue $52,300 of stock. The company was denied permission to issue $1,720,000 of bonds.

A decision was rendered granting to the San Diego Consolidated Gas & Electric Company to issue $27,000 of bonds for additions and betterments to the company's plant.

The Spring Valley Water Company was granted authority to issue a promissory note in the sum of $300,000. The proceeds will be used for new construction and to pay off mortgage indebtedness.

A decision was rendered granting authority to the San Francisco Chamber of Commerce, reducing the rate on clay on the Southern Pacific into South San Francisco, East Oakland and Alameda from $1.25 to 85 cents per ton. The clay is shipped from points in Amador, Placer and Calaveras counties.

A decision was rendered granting authority to the Dos Palos Telephone Company to issue $1,273 of stock.

NEWS NOTES

FINANCIAL.

LOS ANGELES, CAL.—There is a possibility that the city council may revise its original plan on the power bond issue and pass an ordinance providing for segregation of the two propositions—the one to vote $1,250,000 for the completion of the city's power plant; the other to vote $5,250,000 for the purchase of a distributing system of electrical energy.

INCORPORATIONS.

MYRON, UTAH.—The Myron Electric Light, Water & Power Company has been incorporated here.

LOS ANGELES, CAL.—The Citrus Mesa Water Company has been incorporated.

ILLUMINATION.

PORT ANGELES, WASH.—The franchise applied for by Dann Bros. for a gas plant has been granted.

LEBAM, WASH.—R. L. Fisher has applied for a franchise to construct, maintain and operate an electric light plant and lines in the town of Lebam.

WHITTIER, CAL.—Work of installing the new system of street lights in the business district has been commenced by the Edison company and will be in operation before the holidays.

LOS GATOS, CAL.—The construction department of the Pacific Gas & Electric Company is preparing to lay new 6-in. gas mains along the entire length of Main street at a cost of approximately $15,000 and along Santa Cruz avenue, preparatory to the paving of these streets.

VANCOUVER, B. C.—It is said that the Vancouver Gas Company has been granted an order restraining the authorities from enforcing an ordinance to put the price of gas at 95 cents per 1000, instead of $1.50. Some weeks ago the city council ordered the cut, the same to become effective during the latter half of October; but the company declared that the city council was usurping the power of the public utilities commission.

SAN BERNARDINO, CAL.—In a lengthy opinion Judge B. F. Bledsoe of the Superior Court gave San Bernardino city a sweeping victory over the local gas companies and sustained the dollar gas rate passed by the city council last winter to become effective March 1st. The Southern California Gas Company had enjoined the city from putting the ordinance into effect, maintaining that the old rate of $1.15 was as low as gas could be profitably sold in this city.

ASTORIA, ORE.—The city of Warrenton will hold a special election on November 28th, for the purpose of voting a special 10 mill tax to secure a fund of $4200 to make surveys and do other preliminary work toward establishing a municipal electric light and power plant. If the water commission makes a favorable report on its investigations an election will be held to decide whether the municipality shall be bonded for making the improvements.

COEUR d' ALENE, IDAHO.—The city council has entered into a contract with engineering experts Burns & McDonnell of Kansas City to do expert work on electric light and water rates charged by the Kootenai Power Company, and the Consumers' Company. The contract calls for the complete audit of the Kootenai Power Company and Consumers' Company books for the last five years, with a detailed report of the receipts and disbursements and cost of maintenance. Upon this will be based the value of the plants. The contract for the work is $2000.

MURRAY, UTAH—Geo. A. Husher, the Socialist candidate for Mayor, was re-elected last Thursday. Mayor Husher was first elected two years ago on a platform declaring for the immediate installation of a municipal electric lighting plant for Murray. The plant has been installed and will be ready within the next few weeks to deliver energy. The administration has announced a rate of seven and a half cents per kilowatt-hour for lighting purposes by the municipal plant, as compared with a ten-cent rate formerly charged by the Progress Company. It is expected that the Progress Company will meet the cut.

SOUTH VANCOUVER, B. C.—The council of the municipality of South Vancouver unanimously passed a resolution calling for the establishment of a municipal electric plant. The report of the municipal electrician provided for constructing on electric light and power plant at a cost of $600,000, being $400,000 for the first unit and $200,000 for the second unit, not including cost of the building, with a capacity capable of supplying the needs of the district for the next five years. The report recommended a 2-unit steam generating plant of the turbo-generator units type, with a nominal rating of 2000 kw. and a maximum rating of 2500 kw. with crude oil as fuel. Provision was also made in the estimate for an adequate system of street lighting, includ-in 300 arc lamps and standard lamps for the principal sections.

SAN FRANCISCO, CAL.—The installation of the electric conduits for transmission of light and power at the Panama-Pacific International Exposition has kept pace with the rapid progress of construction work in general. The general distributing cables for the trunk system and all the operating apparatus are in order, and also the apparatus for the decorative lighting, such as projectors. The conduits for the trunk system in the concessions and in the states and foreign districts of the grounds are completed and it only remains now to put in the service leads. The system is as far advanced in the main exhibit district as the progress of work on the palaces and the piles of lumber will permit. Plans for the wiring in the Court of the Four Seasons and in the Court of the Sun and Stars have been completed and bids have been called for.

TRANSPORTATION.

PORTLAND, ORE.—Over the vigorous protest of officials of the Portland Railway, Light & Power Company and representatives of several districts of the city, the city commission voted 3 to 2 for the passage of an ordinance fathered by City Commissioner Daly requiring the street car company to grant six street car rides for 25 cents.

SACRAMENTO, CAL.—The West Sacramento Company is preparing for operation of street cars between Sacramento and the townsite in West Sacramento. A 5c fare is promised and the line is scheduled to be in operation within a short time. Engineers have begun laying the tracks. The Pacific Gas & Electric or the Northern Electric will conduct the line.

WATSONVILLE, CAL.—For the second time in its career of ten years the Watsonville Railway between this city and Port Watsonville has started over the road of receivership, suit having been filed in the Superior Court of Monterey County by the Union Trust Company of San Francisco for a receivership. The complainant company is trustee for the $100,000 bond issue.

SACRAMENTO, CAL.—The railroad commission has issued an order supplemental to its previous order in which it provided that an undergrade crossing should be constructed by the Northern Electric Railway Company and the Cement, Tolenas, & Tidewater Railroad Company near Cement, Solano county. The modified order provides that the under

pass shall be completed on April 28, 1914, and that, in the meantime, the Cement, Tolenas & Tidewater Company, operate its trains over the crossing on an approved signal system.

FRESNO, CAL.—The grading crew on the Fresno Traction Company's San Joaquin River extension has completed about two miles of grading in the past three days and rails for the road have been laid to the Santa Fe. The laying of rails beyond the Santa Fe will start at once and will be carried on as fast as grading work is done. The pole line is about half way to the river and the trolley to the river will probably all be strung within the next ten days.

SEATTLE, WASH.—An ordinance providing for the construction of a second division of the municipal street railway will be introduced at the next council meeting by Councilman Erickson. The route will be from Fourth avenue South and Jackson street to Dearborn street, thence to Rainier avenue and paralleling the tracks of her Seattle, Renton & Southern Street Railway to Columbia City, or possibly beyond that point. A $800,000 bond issue was ratified.

OAKLAND, CAL.—The project of establishing a union depot housing the electric traction lines of the city and providing at Fourteenth and Franklin streets a central distributing point for the passenger traffic of the city, may soon take shape. This announcement is made by Secretary A. R. Dennison of the Chamber of Commerce following correspondence and personal conferences with Paul Shoup, in charge of the electric lines of the Southern Pacific Company and several other high railway officials.

VALLEJO, CAL.—The Northern Electric Railroad Company has assembled construction material here for a resumption of the construction work on the Santa Clara street bridge. Assistant Engineer H. O. Brown states that grading operations will be prosecuted throughout the winter. The heaviest work will be through Jamison Canyon. An overhead crossing will be constructed at Napa Junction. The construction crew is working several miles out of Fairfield. Suisun Creek has been reached.

LOS ANGELES, CAL.—The girder-rail ordinance of this city now in effect, cannot, it is said, be enforced on account of the flaws it is supposed to contain which would probably kill the ordinance if tested in the courts, and the revised ordinance now before the council has been laid over for a week on request of the grand jury. The announcement that the grand jury is taking a hand in the situation and that its members desired to compare the old with the new ordinance had the effect of halting action.

OGDEN, UTAH—A force of men are employed by the Utah Light and Railway Company repairing the damage done to the Pioneer Power Plant last week when the accidental opening of a motor operated gate valve at a time when the turbine case was open flooded the entire power station. C. A. Cohn, superintendent of power stations for the company, is in charge of the work. He reports that the damage was not as serious as at first anticipated and that the plant will be back in commission within a few days.

TACOMA, WASH.—President Farrell of the Oregon & Washington Railroad & Navigation Company has announced that a large ocean warehouse will be constructed by his company on its water front property, indicating that the Union Pacific interests intend to make a strong effort for their share of the Oriental freight business. A plan has been submitted to the Tacoma city council by private interests for the purpose of making arrangements to construct an iron smelter upon a vacant tract of land owned by the city on the tide flats. The project is in a preliminary stage.

FAIRFIELD, CAL.—The Northern Electric Railroad has started aggressive action against land owners in the vicinity of the Vallejo terminal, whom the road alleges are holding out for an exorbitant figure for rights of way privileges. Two important suits have been filed and others near the Vallejo end will probably be filed very shortly. Condemnation proceedings may also be necessary through small tracts near Suisun and the Five Mile House near Napa Junction. Outside of these few setbacks the railroad officials declare the prospects for an early completion of the system are very good.

POCATELLO, IDAHO—It was recently announced by J. B. Browning of Pocatello and Cleveland, Ohio, that he had succeeded in interesting Salt Lake and Eastern capital in the installation of an interurban extension from here to Fort Hall, which will run through a rich farming section and tap several of the small towns which lie adjacent to the county seat of Bannock County. It is stated that orders will soon be placed for the steel and that construction work will start as soon as material can be delivered. Mr. Browning was assisted in his negotiations by L. L. Evans of American Falls, Idaho. It is proposed to operate a storage battery system of transportation. The franchise for the system was obtained about eighteen months ago. The storage battery system was decided upon on account of the lower first cost and up-keep as compared with the trolley system.

SAN FRANCISCO, CAL.—The city engineer has about completed the specifications for the hundred new cars which are to be procured for use on the proposed extensions of the Municipal Railway system. Proposals for the construction of the cars will soon be invited, as this will take longer than any other work connected with the enlargement of the city's system. Rails will next be advertised for. The specifications for rails and other roadbed material are also in process of preparation, as well as plans for the new car barn. Condemnation proceedings to obtain the proposed Potrero avenue site have been instituted. The city engineer has completed his inventory and valuation of such property of the Presidio and Ferries system, the franchise of which expires on December 3, as is likely to prove valuable to the city when it takes over the line.

TRANSMISSION.

DALLAS, ORE.—The installation of 282 horsepower in motors at the Dallas Lumber & Logging Company's mill has been completed and the load connected to the lines of the Oregon Power Company.

LOS ANGELES, CAL.—Power was sent over the new Pacific Light & Power Company's transmission system from the new Big Creek project, 241 miles north of this city. This development makes available an additional 80,000 h.p. of electrical energy for use in this city and Southern California.

SAN BERNARDINO, CAL.—It is announced that the Southern California Edison Company will at once commence the erection of a $500,000 plant near Slide Lake to the Santa Ana Canyon, where preliminary work has been under way for some time. The station will be by far the largest one the Edison company will have next to the Long Beach steam plant.

VANCOUVER, B. C.—An early completion is anticipated by T. R. Connick, San Jose, Cal., of the steel tower, 60,000 volt transmission line which he is erecting between Port Moody and the Lake Buntzen power station for the British Columbia Electric Railway Company. Extraordinary difficulties were encountered as the line runs through wild country. For some sections it was necessary to carry water in bags on horses for mixing the concrete for foundations.

MAPLETON, UTAH—The Utah Power and Light Company are building an extension to their lines approximately five miles in length, and are installing a distribution system to serve this community with electric light and power. The Mapleton bench is one of the most prosperous fruit-growing sections in the State of Utah, owing to the fact that it is swept by warm breezes from the mouth of Hobble Creek Canyon during he critical period for fruit. A franchise is being secured to pass through the town of Springville in order to reach here.

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